Science 8

Module 3

Light and Optical Systems

Home Instructor's Guide and Assignment Booklet 3B

Learning Technologies Branch

Alberta LEARNING

Science 8
Module 3: Light and Optical Systems
Home Instructor's Guide and Assignment Booklet 3B
Learning Technologies Branch
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The Learning Technologies Branch acknowledges with appreciation the Alberta Distance Learning Centre and Pembina Hills Regional Division No. 7 for their review of this Home Instructor's Guide and Assignment Booklet.

This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	✓
General Public	
Other	

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- Alberta Learning, **http://www.learning.gov.ab.ca**
- Learning Technologies Branch, **http://www.learning.gov.ab.ca/ltb**
- Learning Resources Centre, **http://www.lrc.learning.gov.ab.ca**

The use of the Internet is optional. Exploring the electronic information superhighway can be educational and entertaining. However, be aware that these computer networks are not censored. Students may unintentionally or purposely find articles on the Internet that may be offensive or inappropriate. As well, the sources of information are not always cited and the content may not be accurate. Therefore, students may wish to confirm facts with a second source.

Section 2: Vision and Optical Devices

In this section, students investigate and explain how images are formed by lenses. Students describe the significance of image formation in vision, and they compare eyes to cameras. Students explore the functions of old and new technological devices—and their various impacts on science and society by the extension of human vision.

The following materials will be needed to complete this section.

Section 2: Lesson 1

- a flashlight
- a comb
- a concave lens
- a convex lens
- plastic wrap
- a candle
- matches
- a compass from a geometry set
- a dish to hold the candle
- a book
- a pair of scissors
- a ruler
- a tape measure or a metre-stick
- masking tape
- a black Bristol board (20 cm by 15 cm—three pieces) or cardboard
- white paper

Section 2: Lesson 2

- two convex lenses—one having a greater surface curvature but the same diameter as the other
- a black Bristol board (20 cm by 15 cm—three pieces) or cardboard
- a pair of scissors
- masking tape
- a book

Suggested Answers

Section 2: Lesson 1

10. The student's data table should be set up in this way.

Combining Lenses (for example)		
Object Distance (cm)	**Image Distance (cm)**	**Image Size (larger, smaller, same size)**

Check for these items: a title; column headings and units in column heading; using a pencil and ruler or computer-generated table; the appropriate size.

11. Answers will vary. A table would start in this way.

Combining Lenses (for example)		
Object Distance (cm)	**Image Distance (cm)**	**Image Size (larger, smaller, same size)**
95	5.0	smaller
85	5.0	smaller
75	5.1	smaller

Note: The first column does not start at 100 cm. This is because the lens is between the object and the screen.

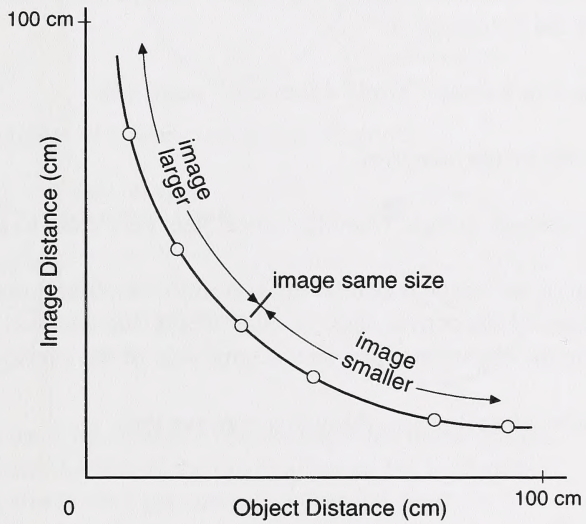
The table data would continue in this way:

- The smaller the object distance, the larger the image distance.
- The image size is equal to the object size only if the image distance equals the object distance.
- The image size is greater only if the image distance is greater than the object distance.

12. Textbook question 1 of "Analyze," page 214:

The student's line graph should be similar to the following example.

Object Distance Versus Image Distance



21. Answers will vary depending on which animal eye is chosen. The student response should show comparisons to the human eye. A drawing would make the presentation more effective.

The following is some information that the student may have included:

- The human eye is round and has a cornea, a lens, and a retina.
- An octopus eye is similar to a human eye, but the lens does not change shape. Instead, the lens moves backward or forward to make a focused image on the retina.
- In fish eyes the lens is round, not oval. The lens sticks out of the pupil and so can gather light from all around. This allows a fish to see in all directions without moving its head.

- Birds have five types of cones in the retina. Cones are colour-sensitive cells. Humans have only three types of cones. Birds can tell more colours apart—this sharper vision is helpful in spotting food.

- Owls have a layer in the eye that reflects light inside the eye. This reflecting layer allows owls to see well at night.

- Insects have compound eyes. Each eye is made up of many small units. Each of these units is almost like an eye on its own. But each unit detects only one dot of an image. A compound eye is very good at detecting motion. This allows a housefly to get out of the way of a fly swatter or another danger. Compound eyes are not as effective in forming whole images.

Discuss the information with your student. Have your student make notes of the information about eyes that the student did not research.

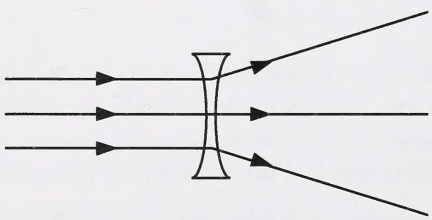
22. Textbook questions 1 to 4 from "Topic 4 Review," page 220:

1. (a) The size of the image increases.

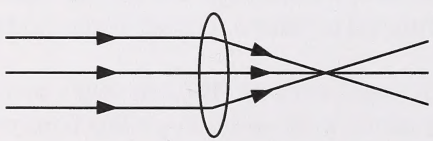
(b) The image becomes upright when the object gets very close to a convex lens.

(c) The location of the image is behind the lens until the object comes very close—it's then located in front of the convex lens. In other words, the image is first on the opposite side of the lens from the object and then on the same side of the lens as the object.

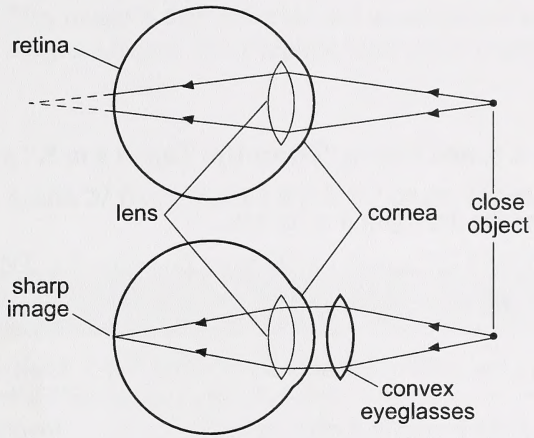
2. (a) Light diverges when it passes through a concave lens.



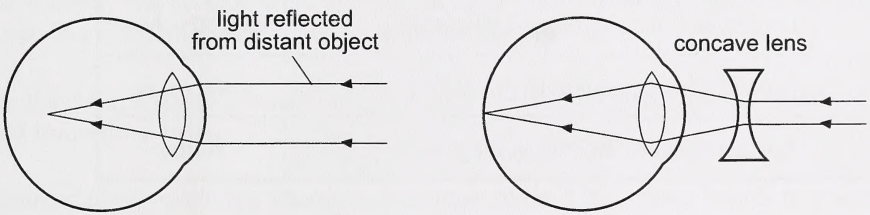
(b) Light converges when it passes through a convex lens.



3. **(a)** Note the following far-sightedness diagram.



(b) Here's an example of a near-sightedness diagram.



4. **(a)** The retina is the light-sensitive screen where the image forms.
   (b) The iris controls the size of the opening where the light enters.
   (c) The opening where the light enters is called the pupil.
   (d) The lens focuses light into a real image.

Section 2: Lesson 2

8. **Textbook questions 1 to 3 from "Topic 3 Review," page 226:**

1. **(a)** The objective lens, or mirror, in a telescope gathers light rays from a distant object and converges them to form a real, inverted, and smaller image.

   (b) The eyepiece lens of a telescope acts like a magnifying glass—it forms a larger virtual image of the real image formed by the objective lens.

2. **(a)** The eyepiece lens of a refracting telescope has the greatest curve.
   (b) The objective lens of a compound microscope usually has the greatest curve.

3. Binocular prisms use reflection to allow for shorter distances between the lenses. This makes the binoculars more compact. **Note:** The prisms also make the image upright. Without the prisms, the image would be upside down.

Section 2: Review

Textbook questions 1, 2, 4, 5, and 7 from "Wrap-Up: Topics 4 to 5," page 227:

1. Each term matches the description to its left.

Description	Term
the point where the optic nerve enters the retina	**blind spot**
attitude of the image in a microscope	**inverted**
controls the size of the pupil	**iris**
largest lens in a refracting telescope	**objective lens**
path from the retina to the brain	**optic nerve**
corresponds to the film in a camera	**retina**

2. The smaller, real, inverted image increases in size as an object moves closer to a convex lens. If the object is very close to the lens, then an upright, larger, virtual image is formed on the same side of the lens as the object.

4. In a refracting telescope, light from a distant object is gathered and focused by a convex objective lens. The eyepiece—a second convex lens—magnifies the image.

   In a reflecting telescope the light is collected and focused by a concave objective mirror. The eyepiece is a convex magnifying lens.

5. Two convex lenses are used in a microscope. The convex objective lens collects light from the object and focuses it to form an inverted, enlarged, and real image. The convex eyepiece lens forms an erect, enlarged, and virtual image of the real image. However, since the real image is inverted, the virtual image is also inverted compared to the object.

   Note: Remember that an *e* placed on the microscope stage in the upright position was inverted when viewed through the microscope.

7. Binoculars are two telescopes that are placed side by side to create a 3-D image. Using prisms decreases the length of the tubes. The first convex lens gathers and focuses light to produce a real, inverted image. This image is then reflected and reversed by the prism to form an erect image in front of the eyepiece lenses. The eyepiece lenses then magnify the image.

Module Review

Textbook questions 1 to 3, 6, and 27 from "Unit 3 Review," pages 262 to 265:

1. **(a)** An INCANDESCENT bulb gives off more HEAT than a FLUORESCENT bulb.
   (b) The ANGLE of INCIDENCE equals the ANGLE of REFLECTION.
   (c) REFRACTION is the BENDING of LIGHT.
   (d) The LENS in a CAMERA forms a REAL image on the FILM.
   (e) The OWL has large PUPILS to see in the dark.

2. In the illustration the surface to the left of the candle is transparent, so light is transmitted. The surface behind the candle is opaque; light is mostly absorbed, and some is reflected in a diffused or scattered manner. The surface to the right of the candle is translucent—most of the light is transmitted in a diffused manner, while some is reflected.

3. The Sun, the stars, and fire are natural light sources. Artificial light sources include incandescent bulbs and fluorescent tubes.

6. An accommodation, which is a change in the shape of the lens, allows people to maintain a sharp focus as the viewing distance changes. As the friend moves away, the lens in the eye must become thinner.

27. To gather as much light as possible, a telescope must have the largest possible objective lens or mirror. Size and expense is a limitation. It is very difficult to grind huge, flawless lenses and mirrors. The telescope's bulk and mass could make it difficult to transport or change position. Over time, a massive telescope could sag under its own weight and distort the image.

ASSIGNMENT BOOKLET 3B

Science 8
Module 3: Section 2 Assignment and Final Module Assignment

Home Instructor's and Student's Comments:

STUDENT FILE NUMBER
(if label is missing or incorrect)

_____

Date Submitted:

_____

Apply Module Label Here

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Please verify that preprinted label is for correct course and module.

FOR SCHOOL USE ONLY

Assigned Teacher:

_____

Date Assignment Received:

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Grading:

_____

Teacher's Comments

_____

Teacher's Signature

Home Instructor: Keep this sheet when it is returned to you as a record of the student's progress.

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- Has your work been reread to be sure the spelling and details are correct?
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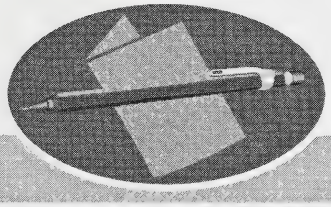
Science 8

Module 3

Light and Optical Systems

Assignment Booklet 3B



Learning Technologies Branch

Alberta LEARNING

FOR TEACHER'S USE ONLY

Summary

	Total Possible Marks	Your Mark
Section 2 Assignment	32	
Final Module Assignment	38	
	70	

Teacher's Comments

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Module 3: Light and Optical Systems
Assignment Booklet 3B
Section 2 Assignment and Final Module Assignment
Learning Technologies Branch

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ASSIGNMENT BOOKLET 3B
SCIENCE 8: MODULE 3
SECTION 2 ASSIGNMENT AND FINAL MODULE ASSIGNMENT

Your mark for this module will be determined in part by how well you do your assignments.

This Assignment Booklet is worth 70 marks out of the total 118 marks for the assignments in Module 3. The value of each assignment and each question is stated in the left margin.

Work slowly and carefully. If you have difficulty, go back and review the appropriate section.

Be sure to proofread your answers carefully.

(32)

Section 2 Assignment: Vision and Optical Devices

Read all parts of your assignment carefully and record your answers in the appropriate places.

1. In Lesson 1 you investigated the formation of images. You used a convex lens and a screen to make a simple "camera."

(1) **a.** As the object moves toward the camera, which way must the lens move to keep the image focused?

_____

(1) **b.** What happens to the image distance as the object distance decreases?

_____

(1) **c.** How would these distances compare when the object and image are the same size?

_____

(2) **d.** You reduced the diameter of the opening in front of the lens. What happened to the brightness of the image? Do you still see the whole image with a smaller opening?

_____

_____

_____

Return to page 42 of the Student Module Booklet and continue with Lesson 1.

(5)

2. Match the following parts of the human eye and the camera. Place the correct capital letter representing the camera part in the answer blank to the left of each eye part.

	Eye	Camera
_____	**a.** iris	A. aperture
_____	**b.** cillary muscles	B. diaphragm
_____	**c.** eyelid	C. film
_____	**d.** retina	D. focusing ring
_____	**e.** pupil	E. shutter

3. An octopus eye is similar to a human eye. But the lens of the octopus eye cannot change shape. Instead, the lens moves back and forth from the retina. This movement allows the octopus eye to adapt for both near and far objects.

(2) **a.** How does the focusing mechanism of an octopus eye differ from the human eye?

_____

_____

(1) **b.** Which device focuses an image much like an octopus eye?

_____

4. Doctors use laser light to correct certain eye conditions.

(2) **a.** Some eyes are shaped irregularly, instead of being like balls. This prevents clear images from forming. How is laser light used to correct this problem?

_____

_____

(2) **b.** How is laser light used to deal with a detached retina?

_____

_____

5. A certain person has blurred vision. This is due to light converging to a point in front of the person's retina.

(1) **a.** Is this person near-sighted or far-sighted?

_____

(1) **b.** What type of lens does this person need to correct his or her vision?

_____

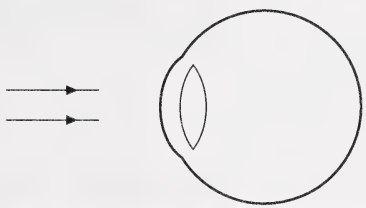
(1) **c.** Explain why the lens helps by using the words *converge* or *diverge*.

_____

_____

(5) **d.** Complete the diagram. Draw in the proper type of lens. Show how the lens will make the person's vision sharp. Label the important parts.

Correcting Vision with a Lens



Return to page 46 of the Student Module Booklet and continue with Lesson 2.

6. Binoculars and telescopes are designed differently.

(2) **a.** Reflecting telescopes usually consist of long, large-diameter tubes. Give two reasons for this design feature.

(1) **b.** Explain how binoculars overcome the problem of length.

(2) **7.** How is a refracting telescope different from a reflecting telescope?

8. Describe how the invention of each of the following instruments led to important new scientific knowledge.

(1) **a.** the telescope

(1) **b.** the microscope

Return to page 51 of the Student Module Booklet and read "Module Summary."

38

Final Module Assignment

The Final Module Assignment is based on Module 3 of the Student Module Booklet and the related textbook pages. Read all parts of your assignment carefully and record your answers in the appropriate places.

(1)

1. State the basic principles of light demonstrated by the following illustrations.

a.

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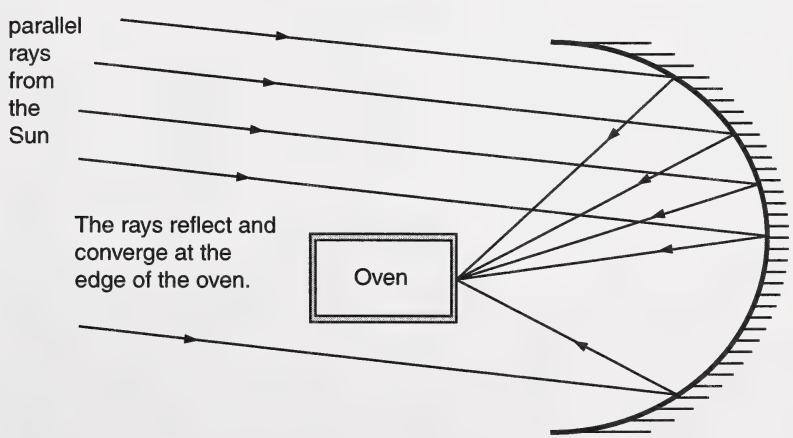
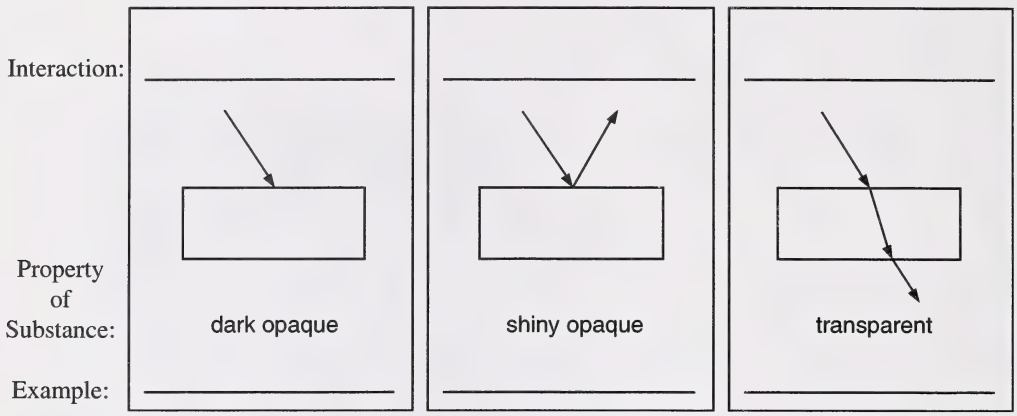
(1)

b.



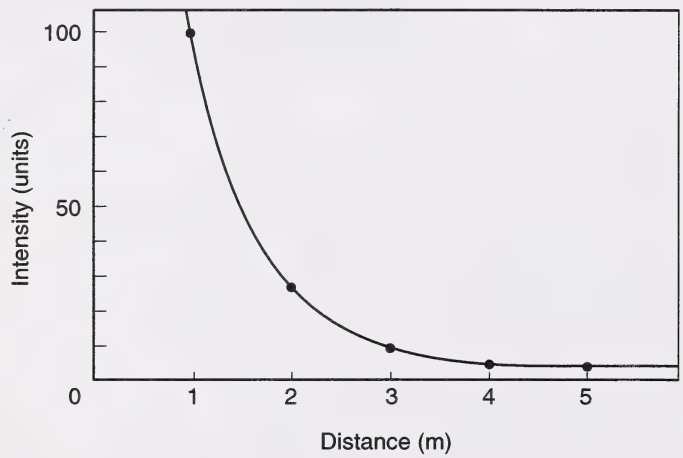
(6)

2. Light interacts with a substance or medium in its path. Light may be transmitted, reflected, or absorbed. Label the following ray diagram sketches to show the three ways light interacts with substances or mediums. Also, label the substances as appropriate examples of dark opaque, shiny opaque, and transparent substances.

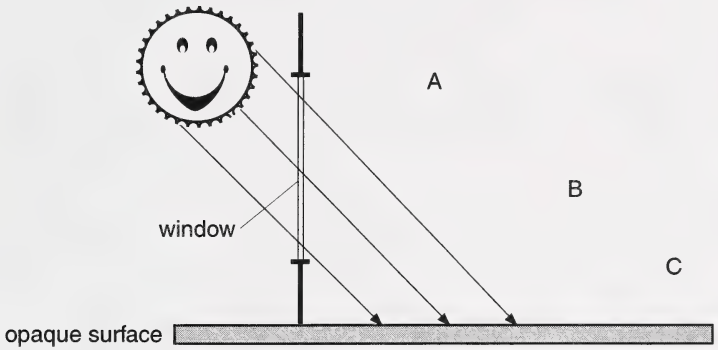


(2)

3. Use the information presented in the following graph to draw a conclusion about the relationship between the distance from the light source and the intensity of the light source.



4. In the diagram the letters *A*, *B*, and *C* each represent a different person. Assume the happy face is far from the window.



(2) **a.** Who will see a reflected, happy face if the surface is rough? Explain.

_____

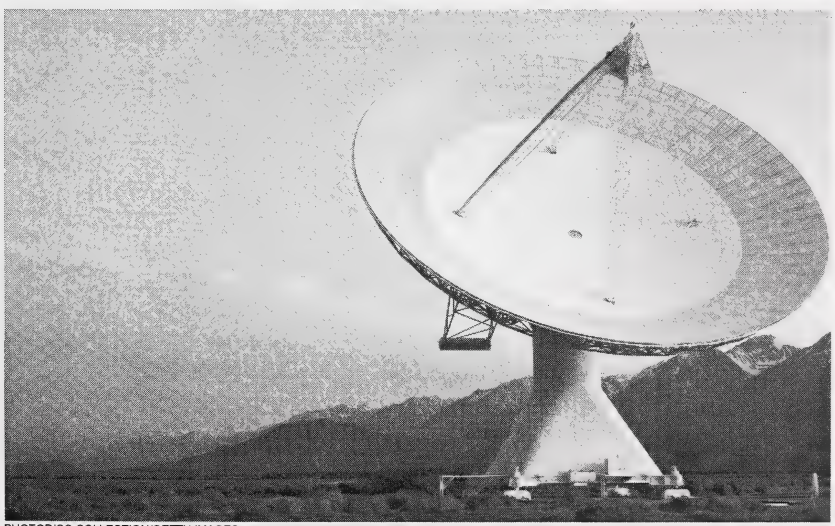
_____

(2) **b.** Who will see a reflected, happy face if the surface is smooth? Explain.

_____

_____

5. Use the following photo of a satellite dish to answer the questions. This satellite dish is used to receive microwaves, which are a type of radiant energy.



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(1) **a.** Classify the shape of the dish. _____

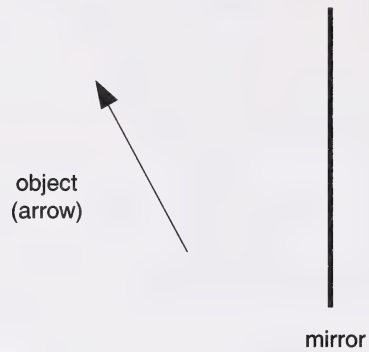
(2) **b.** Explain why the shape of the satellite suits its function.

_____

_____

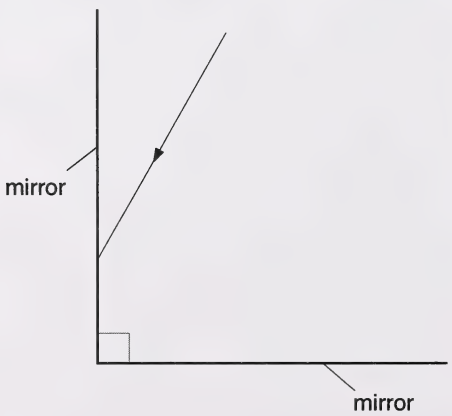
_____

(3) **6.** Refer to page 206 in the textbook. Answer this question by completing the following diagram. Locate and draw the image of the arrow made by the mirror. Show how you located the image.



7. Two mirrors at right angles to each other reflect light in a special way.

(4) **a.** Use the laws of reflection to draw the reflected rays in the following diagram. Draw and label the normal at each point of reflection.



(1)

b. Look at the directions of the light ray striking the first mirror and bouncing off the second mirror. How do the directions compare?

_____

(2)

c. Reflectors left on the Moon by astronauts reflect rays of light back to Earth. These reflectors include mirrors at right angles. Why are mirrors at right angles used instead of just a single mirror?

_____

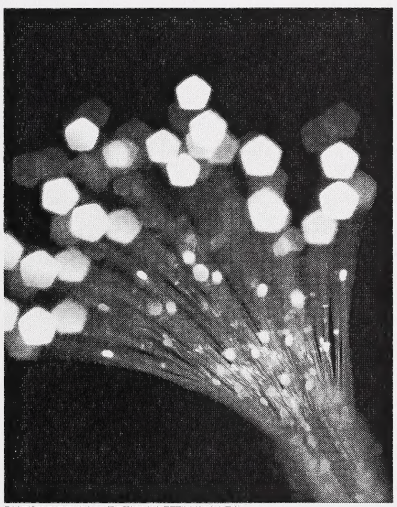
_____

_____

_____

(1)

8. You know that light energy travels in straight lines. In the following fibre-optics photograph the laser light follows the curved path of the fibres. Explain why this is possible.

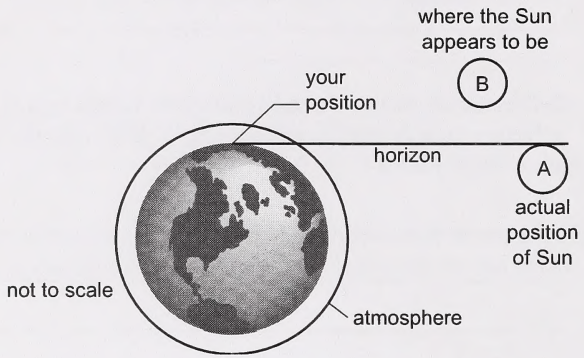


PHOTODISC COLLECTION/GETTY IMAGES

_____

_____

Refer to the following diagram to answer question 9.



(3)

9. Explain why you can see the Sun before it actually rises above the horizon. Be sure to use scientific terms from Module 3. **Hint:** When sunlight travels from the vacuum of space into the atmosphere, it slows down slightly.

(4)

10. In Section 2: Lesson 1, you researched the eyes of other animal species. Describe four specific ways in which the eyes of other animal species differ significantly from human eyes.

(3)

11. Classify the following light sources.

a. Some deep-sea fish use glowing body parts to lure prey.

_____

b. When Aaron turns the light out, the "stars" on his ceiling briefly shine.

_____

c. The red-hot electric stove burner glowed in the dark.

_____

Submit your completed Assignment Booklet 3B to your teacher for assessment.

ASSIGNMENT BOOKLET DECLARATIONS

The Student's Declaration is to be signed by a student registered at the Alberta Distance Learning Centre. If the student is under 16, the Supervisor's Declaration is to be signed by the student's supervisor, who is usually a home instructor, teacher, or home-schooling coordinator. Failure to complete this page may invalidate the assignment results.

STUDENT'S DECLARATION

- I have followed the instructions outlined in the Student Module Booklet.
- I have completed the activities to prepare myself for the assignments in this Assignment Booklet.
- I completed the assignments in this Assignment Booklet by myself.

_____

Student's Signature

SUPERVISOR'S DECLARATION

I hereby certify that I have supervised the learning activities completed by _____.

Student's Name

I also certify that to the best of my knowledge the assignments in this Assignment Booklet were completed independently by this student.

_____

Supervisor's Signature

If you, the student or supervisor, have any comments or observations regarding this module, write them in the following space.

_____

_____

_____

_____

_____

_____

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_____

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_____